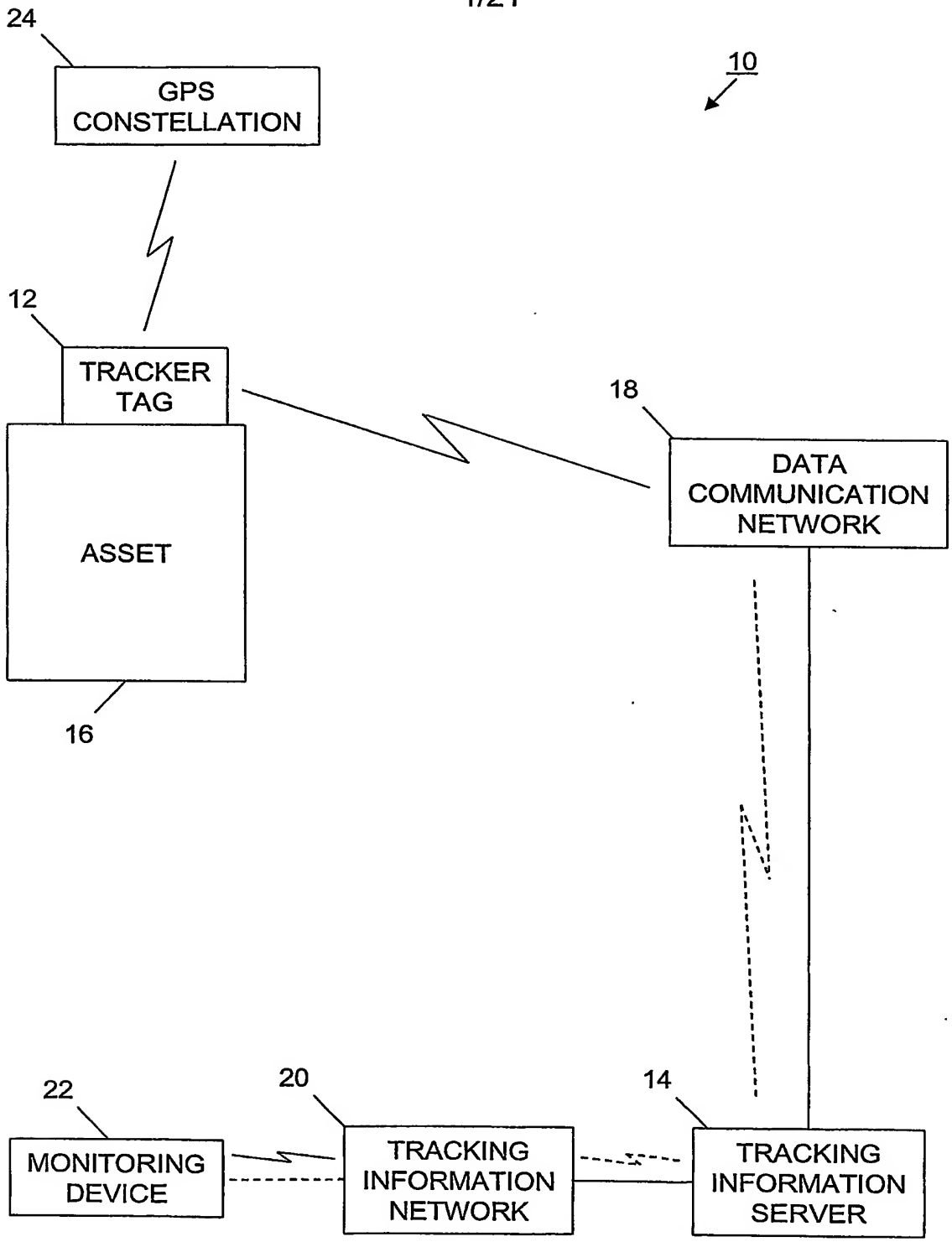
24
GPS CONSTELLATION
10
12
TRACKER TAG
18
DATA COMMUNICATION NETWORK
ASSET
16
22
20
14
MONITORING DEVICE
TRACKING INFORMATION NETWORK
TRACKING INFORMATION SERVER

FIG. 1

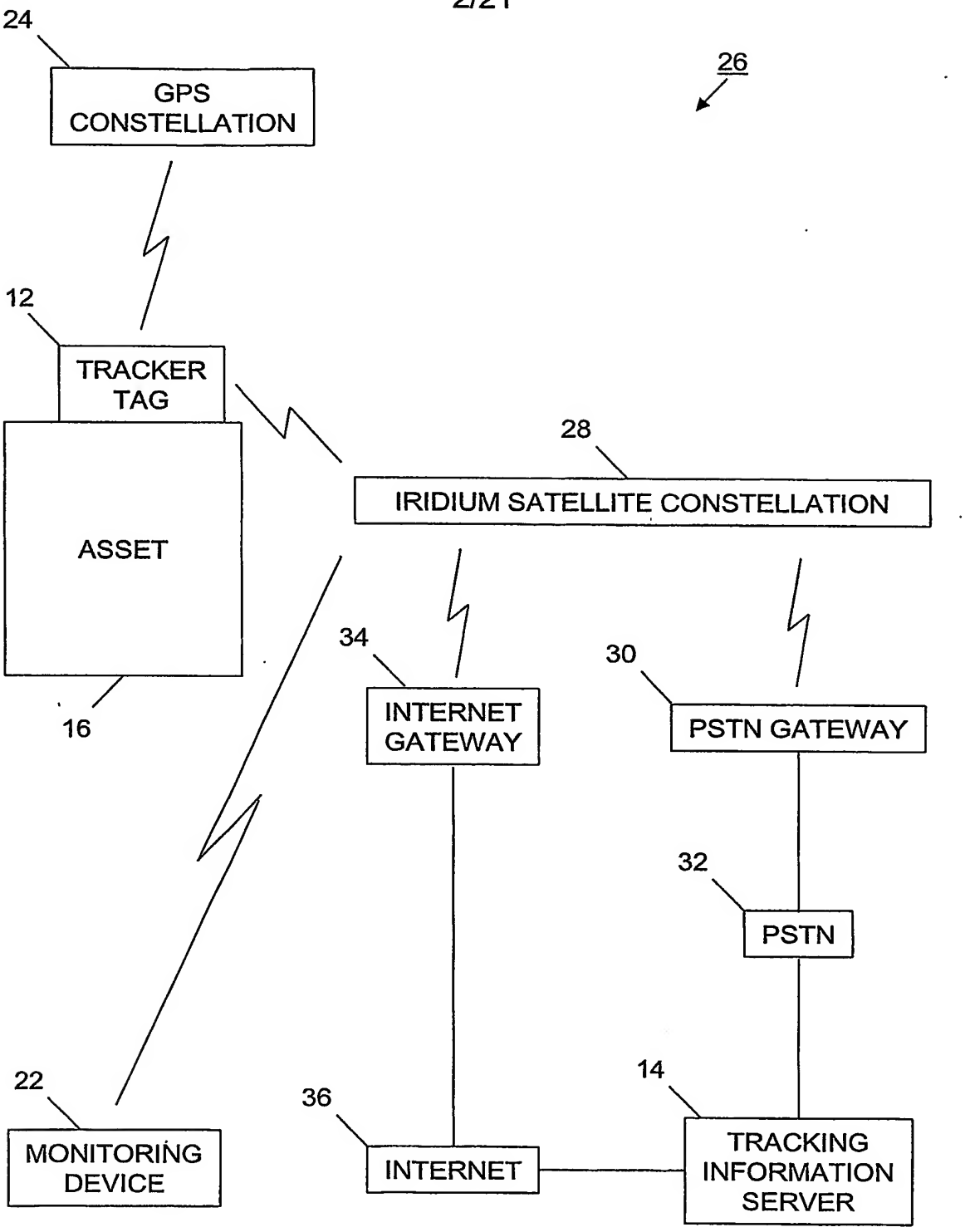
24
GPS CONSTELLATION
26
12
TRACKER TAG
ASSET
16
28
IRIDIUM SATELLITE CONSTELLATION
34
INTERNET GATEWAY
30
PSTN GATEWAY
32
PSTN
22
MONITORING DEVICE
36
INTERNET
14
TRACKING INFORMATION SERVER

FIG. 2

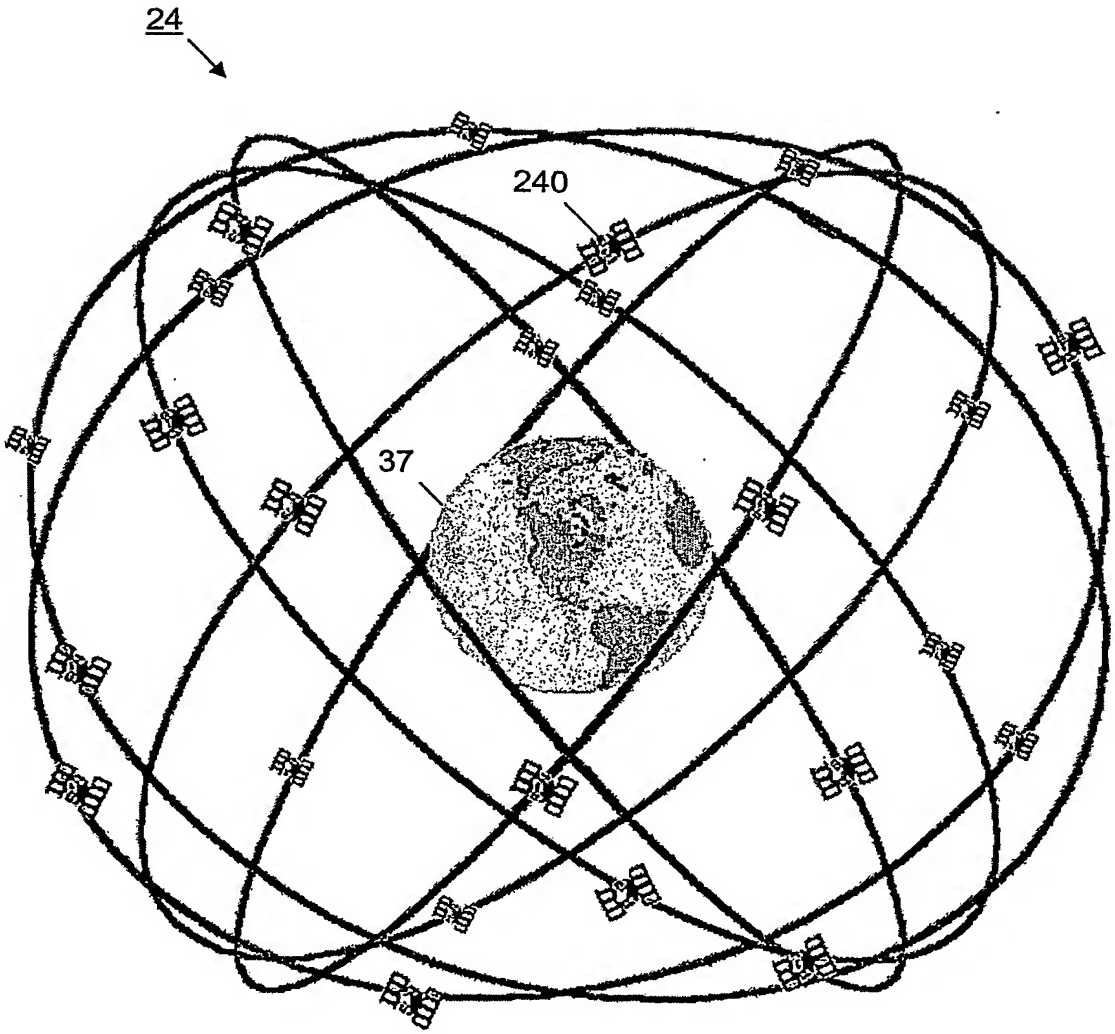

FIG. 3

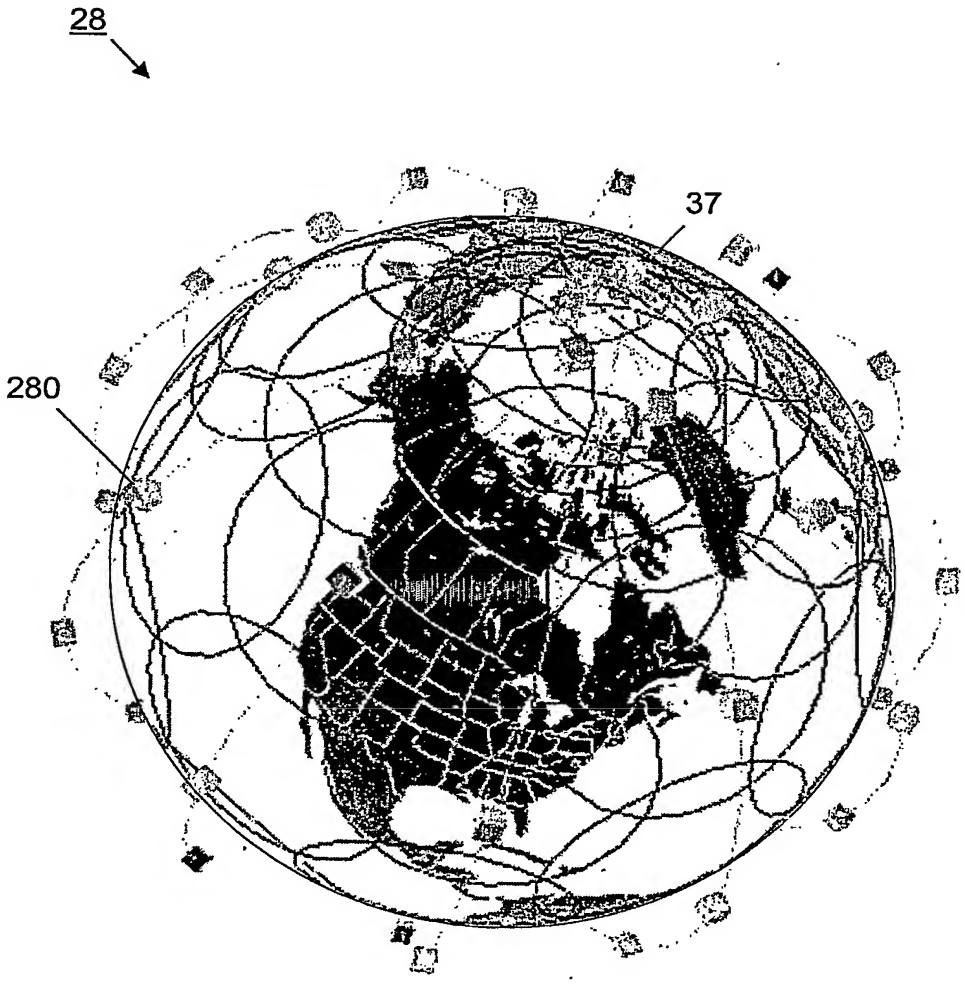

FIG. 4

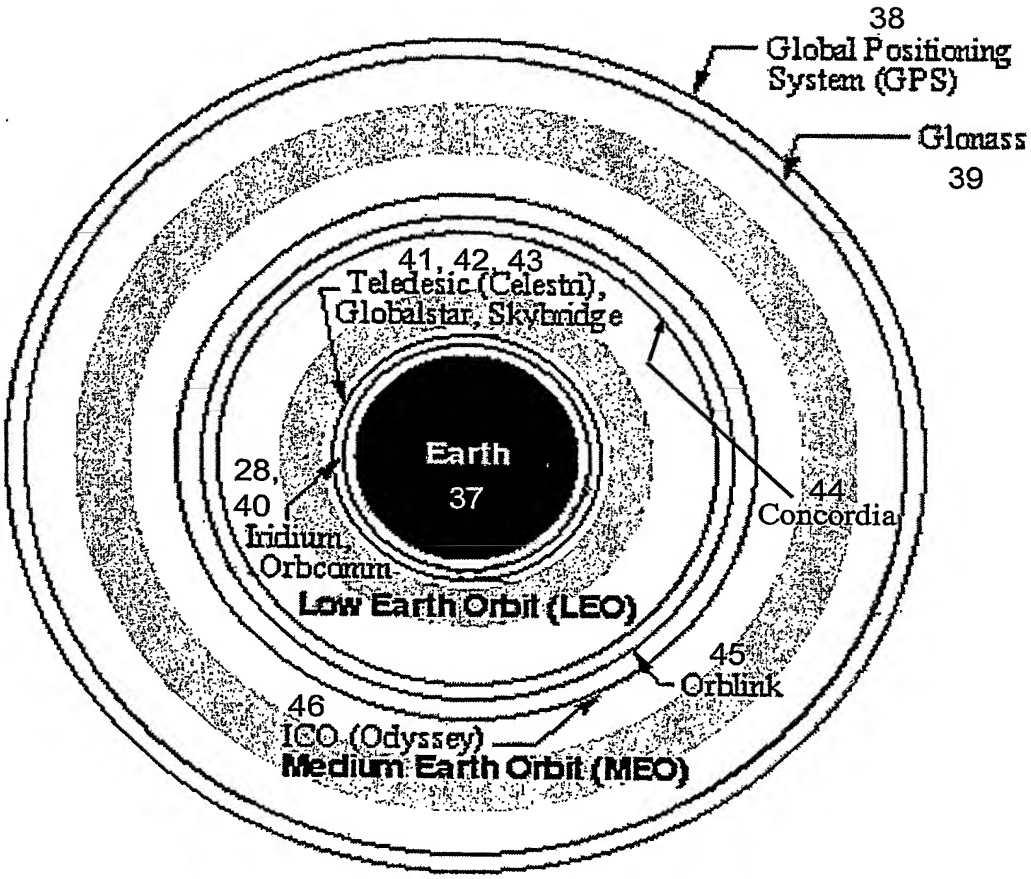
38
Global Positioning System (GPS)
Glonass
39
41, 42, 43
Teledesic (Celestri), Globalstar, Skybridge
Earth
37
28, 40
Iridium, Orbcomm
Low Earth Orbit (LEO)
44
Concordia
45
Orblink
46
ICO (Odyssey)
Medium Earth Orbit (MEO)

FIG. 5

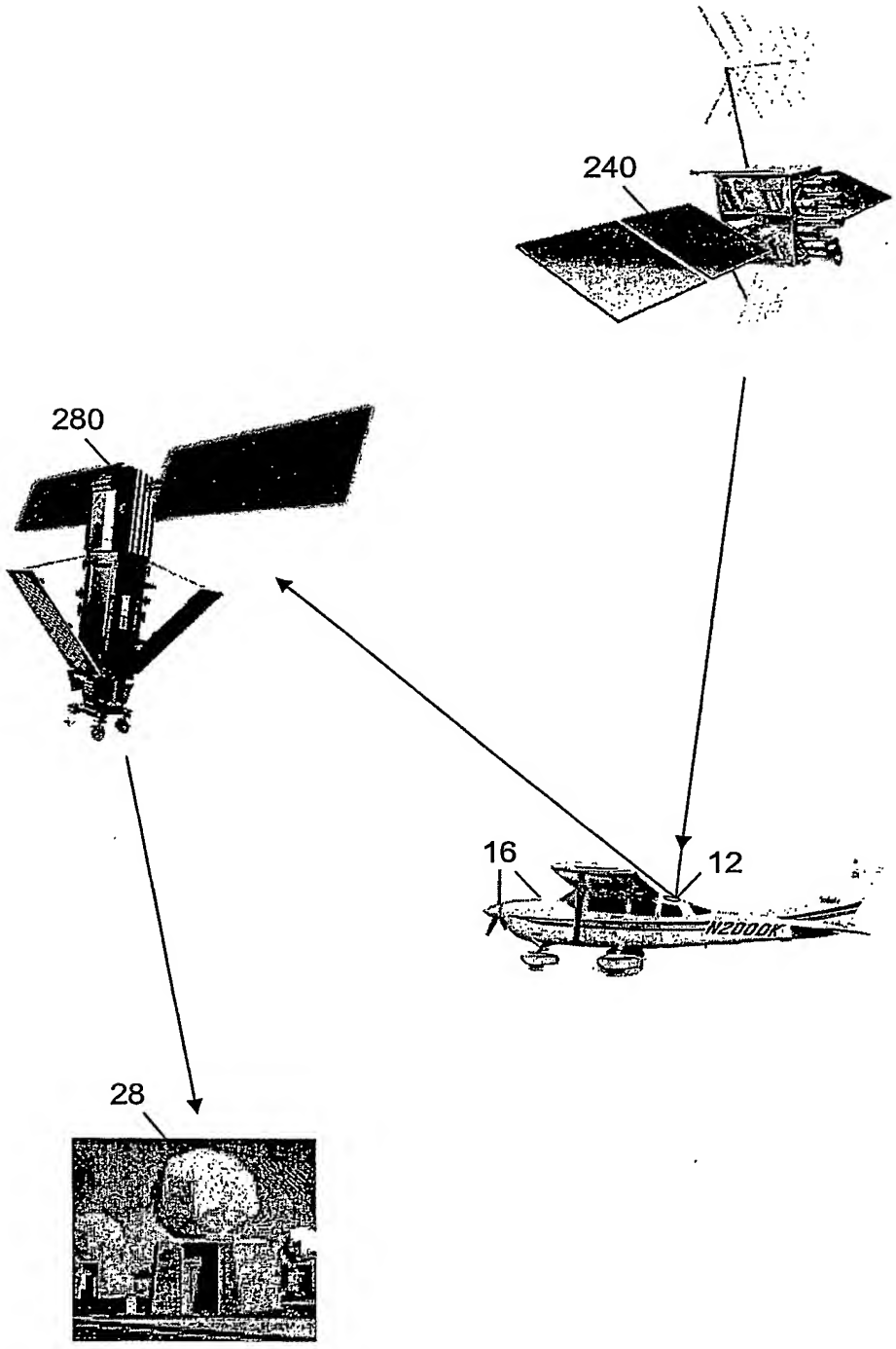

FIG. 6

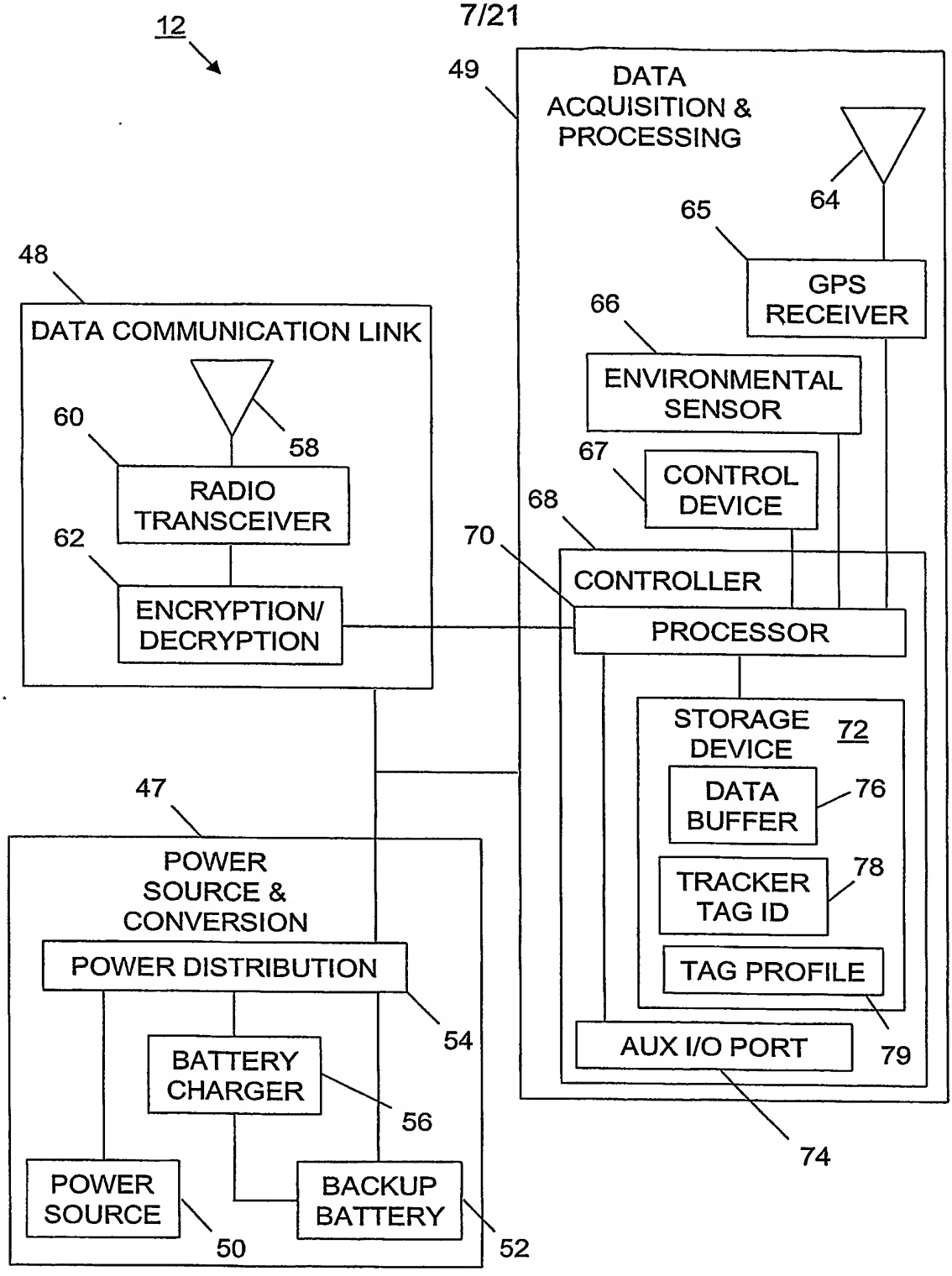
12
49
DATA ACQUISITION & PROCESSING
64
65
GPS RECEIVER
66
ENVIRONMENTAL SENSOR
67
CONTROL DEVICE
68
70
CONTROLLER
PROCESSOR
STORAGE DEVICE
72
DATA BUFFER
76
TRACKER TAG ID
78
TAG PROFILE
AUX I/O PORT
79
74
48
DATA COMMUNICATION LINK
60
58
RADIO TRANSCEIVER
62
ENCRYPTION/ DECRYPTION
47
POWER SOURCE & CONVERSION
POWER DISTRIBUTION
54
BATTERY CHARGER
56
POWER SOURCE
50
BACKUP BATTERY
52

FIG. 7

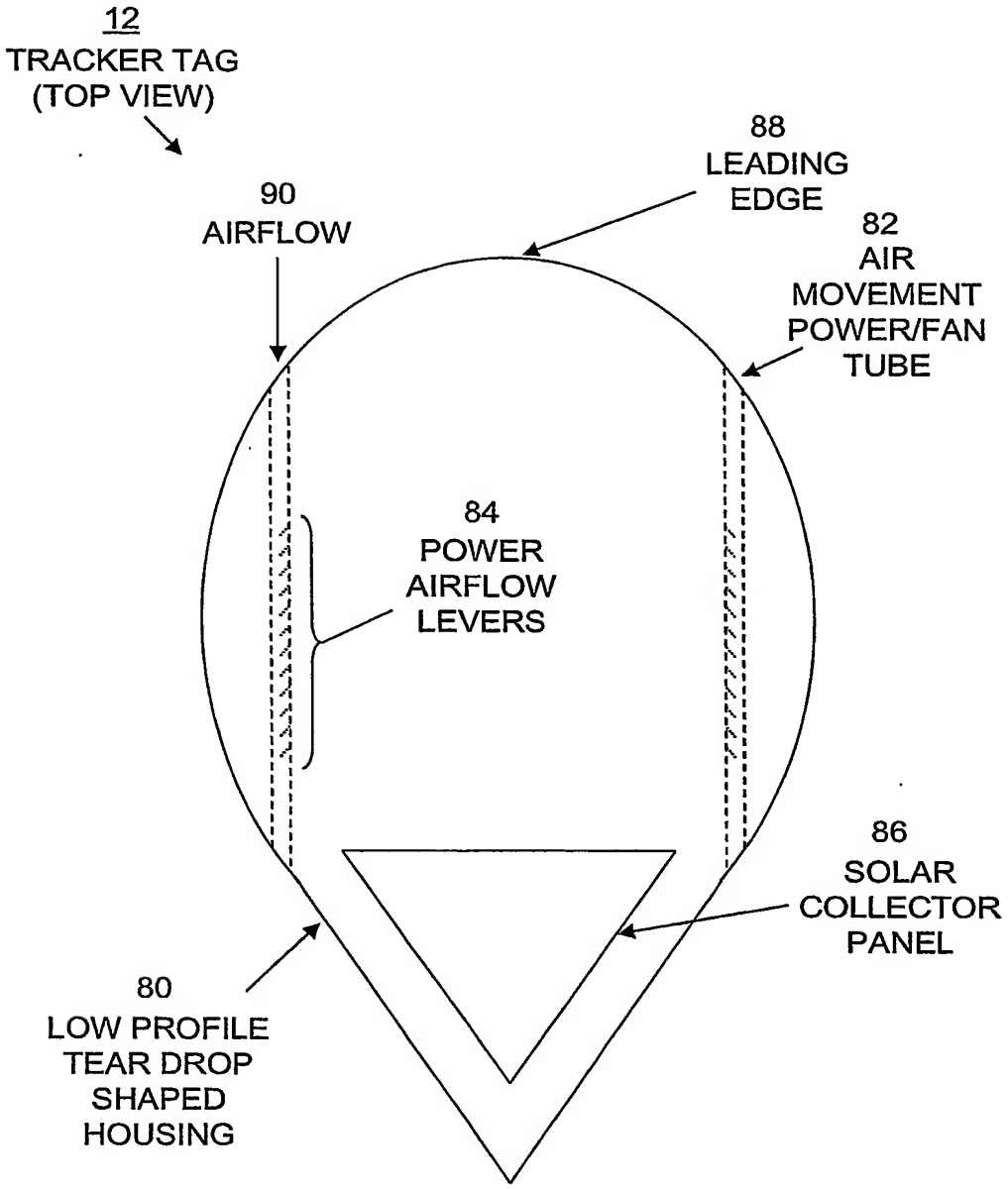
12
TRACKER TAG
(TOP VIEW)
88
LEADING
EDGE
90
AIRFLOW
82
AIR
MOVEMENT
POWER/FAN
TUBE
84
POWER
AIRFLOW
LEVERS
86
SOLAR
COLLECTOR
PANEL
80
LOW PROFILE
TEAR DROP
SHAPED
HOUSING

FIG. 8

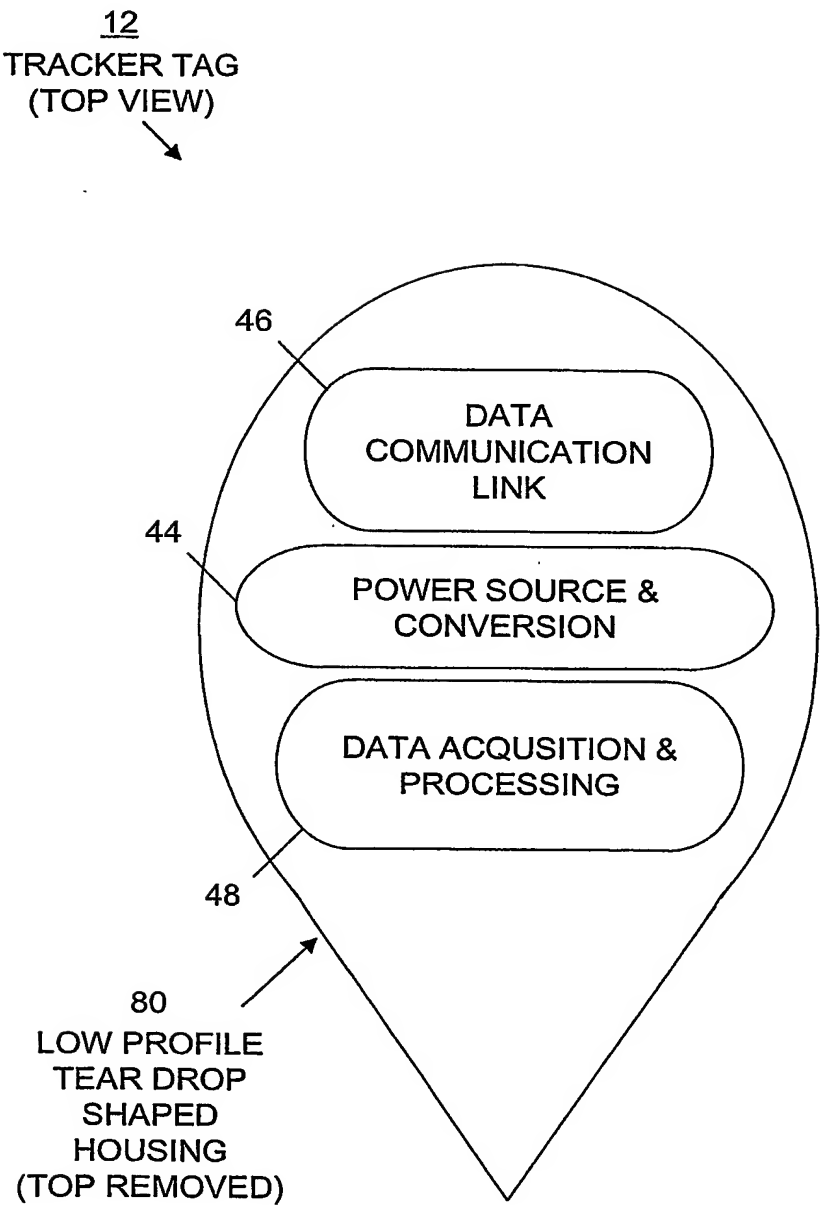
12
TRACKER TAG
(TOP VIEW)
46
DATA
COMMUNICATION
LINK
44
POWER SOURCE &
CONVERSION
DATA ACQUSITION &
PROCESSING
48
80
LOW PROFILE
TEAR DROP
SHAPED
HOUSING
(TOP REMOVED)

FIG. 9

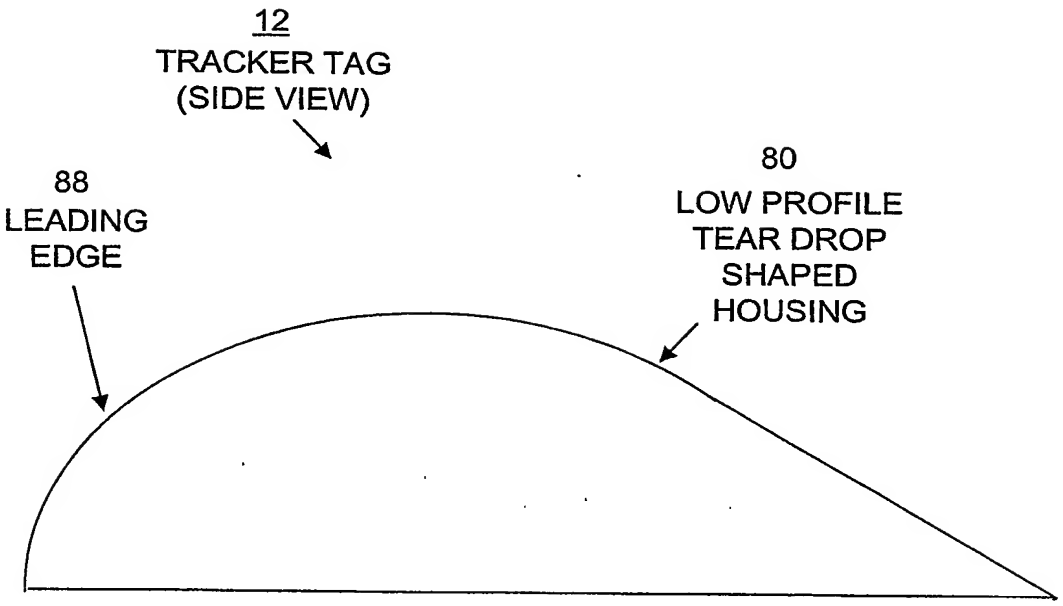
12
TRACKER TAG
(SIDE VIEW)
88
LEADING
EDGE
80
LOW PROFILE
TEAR DROP
SHAPED
HOUSING

FIG. 10

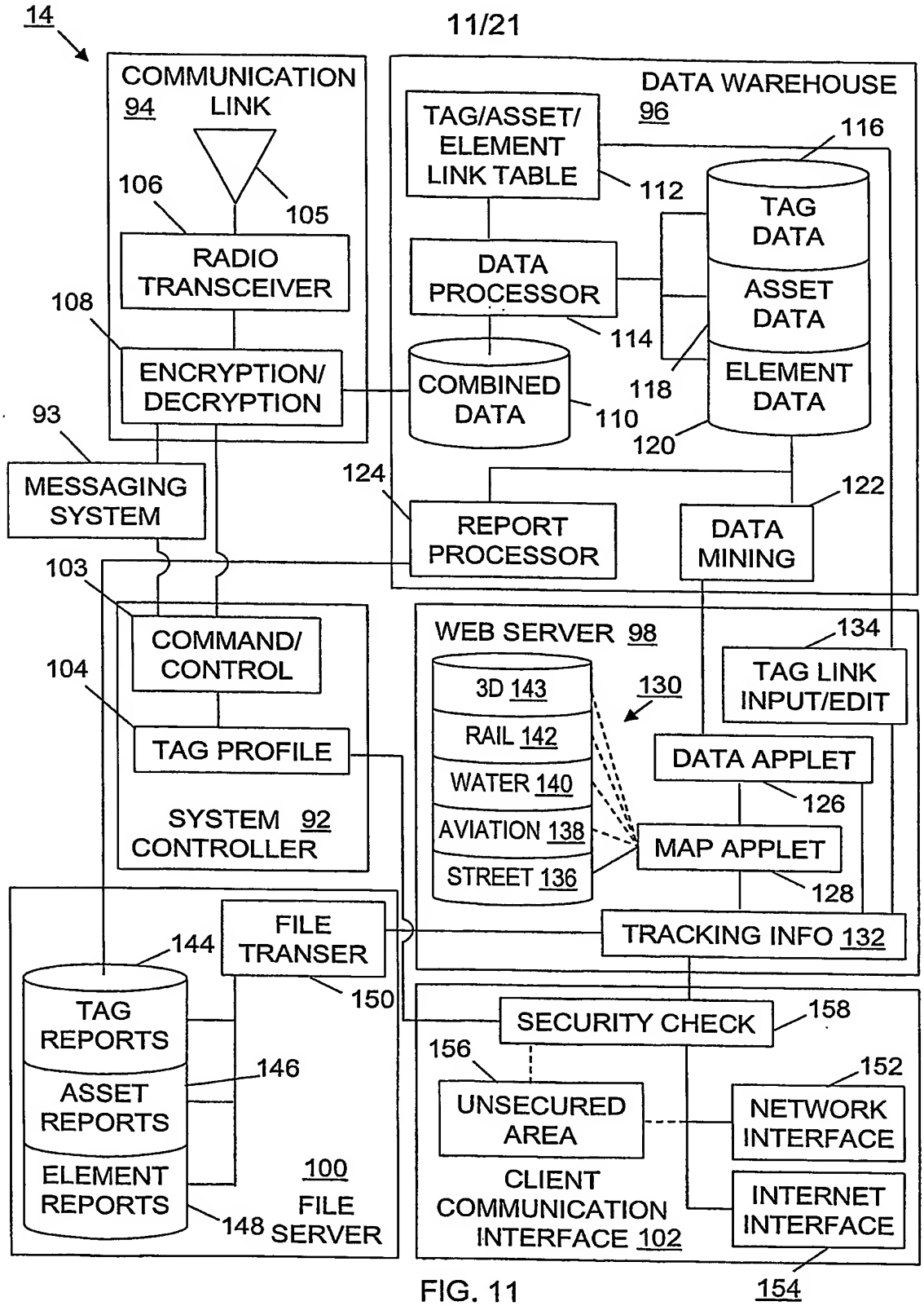
14
COMMUNICATION LINK 94
106
105
RADIO TRANSCEIVER
108
ENCRYPTION/ DECRYPTION
93
MESSAGING SYSTEM
103
COMMAND/ CONTROL
104
TAG PROFILE
SYSTEM 92 CONTROLLER
DATA WAREHOUSE 96
TAG/ASSET/ ELEMENT LINK TABLE
112
116
TAG DATA
ASSET DATA
ELEMENT DATA
DATA PROCESSOR
114
COMBINED DATA
110
118
120
124
REPORT PROCESSOR
122
DATA MINING
WEB SERVER 98
134
TAG LINK INPUT/EDIT
3D 143
130
RAIL 142
WATER 140
AVIATION 138
STREET 136
DATA APPLET
126
MAP APPLET
128
TRACKING INFO 132
FILE TRANSER
144
150
TAG REPORTS
146
ASSET REPORTS
ELEMENT REPORTS
148
100 FILE SERVER
SECURITY CHECK
158
156
UNSECURED AREA
152
NETWORK INTERFACE
CLIENT COMMUNICATION INTERFACE 102
INTERNET INTERFACE
154

FIG. 11

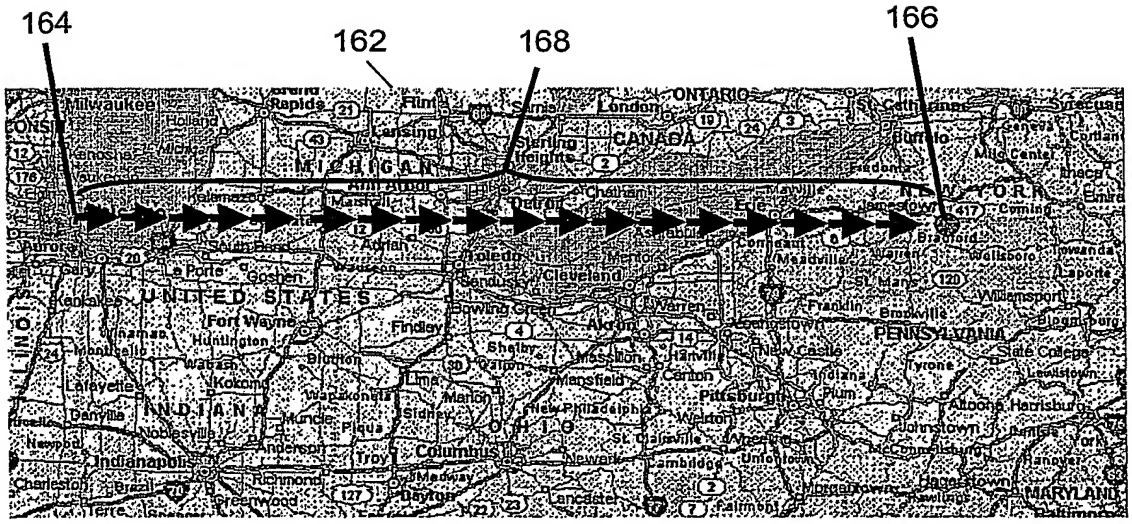
160
164
162
168
166
ONTARIO
CANADA
MICHIGAN
UNITED STATES
INDIANA
OHIO
PENNSYLVANIA
MARYLAND
Milwaukee
Chicago
Detroit
Cleveland
Columbus
Indianapolis
Pittsburgh
Buffalo
Toronto
London
Windsor
Fort Wayne
Akron
Harrisburg
Johnstown
State College

FIG. 12

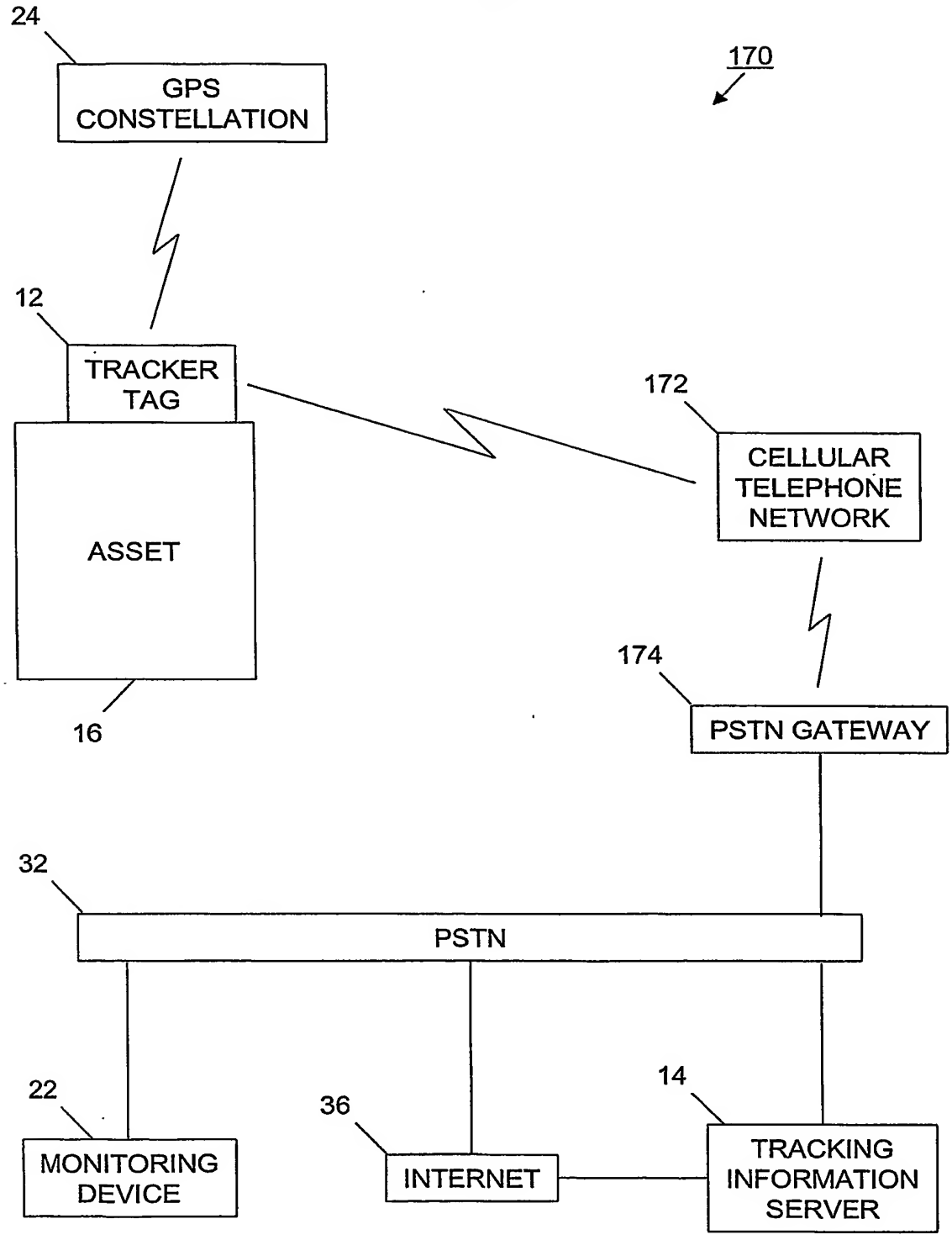
24
GPS CONSTELLATION
170
12
TRACKER TAG
ASSET
16
172
CELLULAR TELEPHONE NETWORK
174
PSTN GATEWAY
32
PSTN
22
MONITORING DEVICE
36
INTERNET
14
TRACKING INFORMATION SERVER

FIG. 13

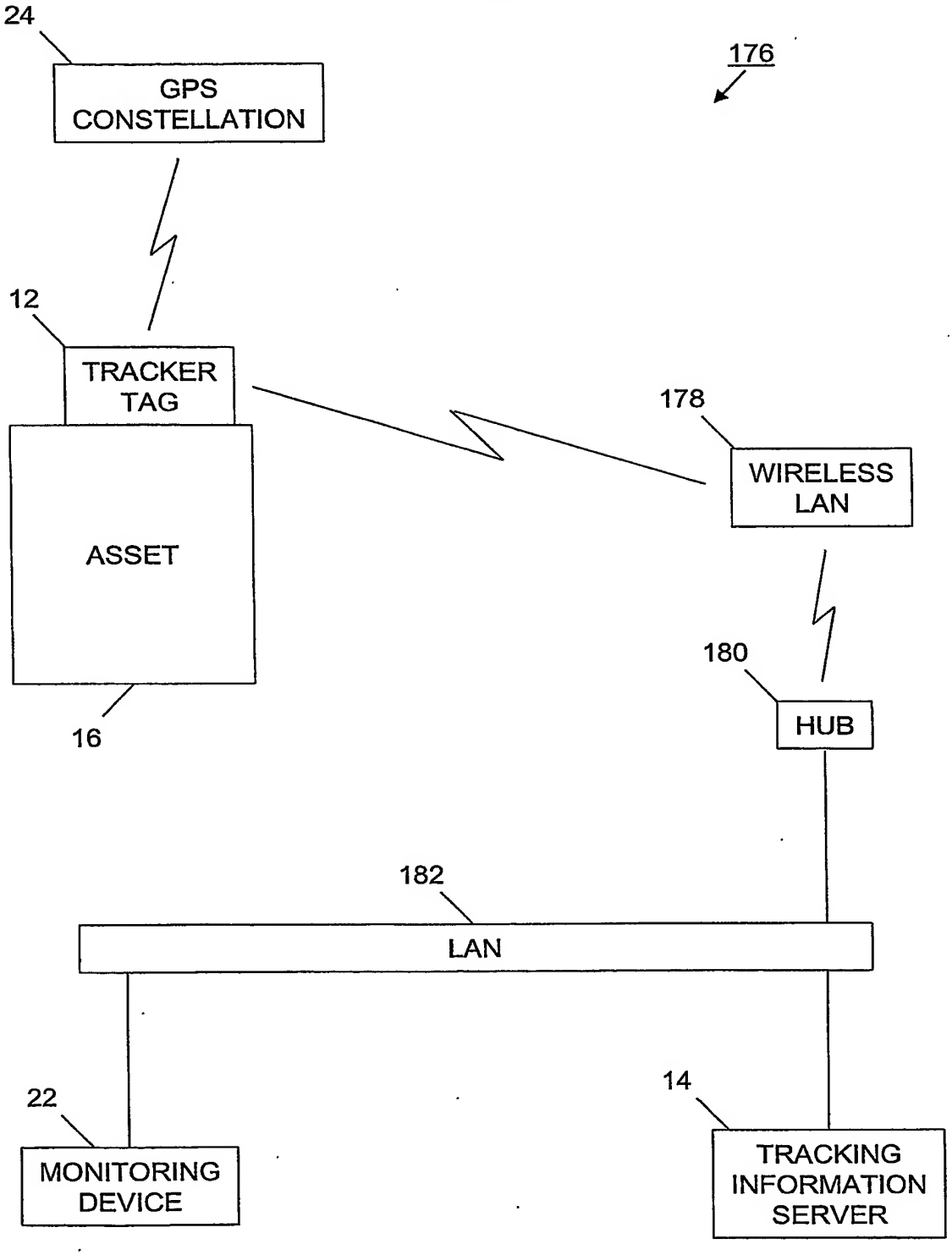
24
GPS CONSTELLATION
176
12
TRACKER TAG
178
WIRELESS LAN
ASSET
180
HUB
16
182
LAN
22
MONITORING DEVICE
14
TRACKING INFORMATION SERVER

FIG. 14

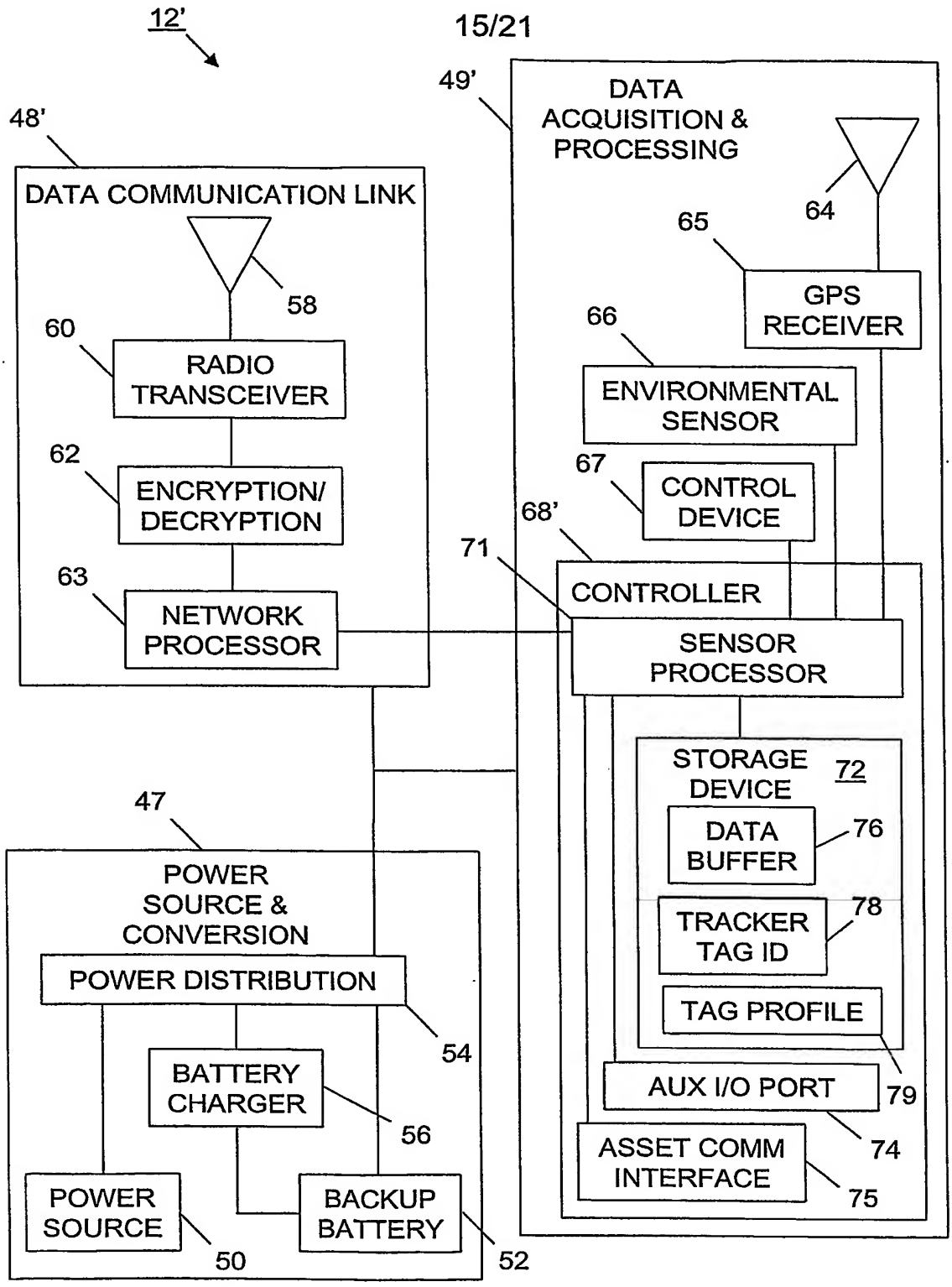
12'
15/21
49'
DATA ACQUISITION & PROCESSING
48'
DATA COMMUNICATION LINK
64
65
GPS RECEIVER
58
60
RADIO TRANSCEIVER
66
ENVIRONMENTAL SENSOR
62
ENCRYPTION/ DECRYPTION
67
CONTROL DEVICE
68'
71
CONTROLLER
63
NETWORK PROCESSOR
SENSOR PROCESSOR
STORAGE DEVICE 72
47
DATA BUFFER 76
POWER SOURCE & CONVERSION
TRACKER TAG ID 78
POWER DISTRIBUTION
TAG PROFILE
54
BATTERY CHARGER
AUX I/O PORT 79
56
74
ASSET COMM INTERFACE
75
POWER SOURCE
BACKUP BATTERY
50
52

FIG. 15

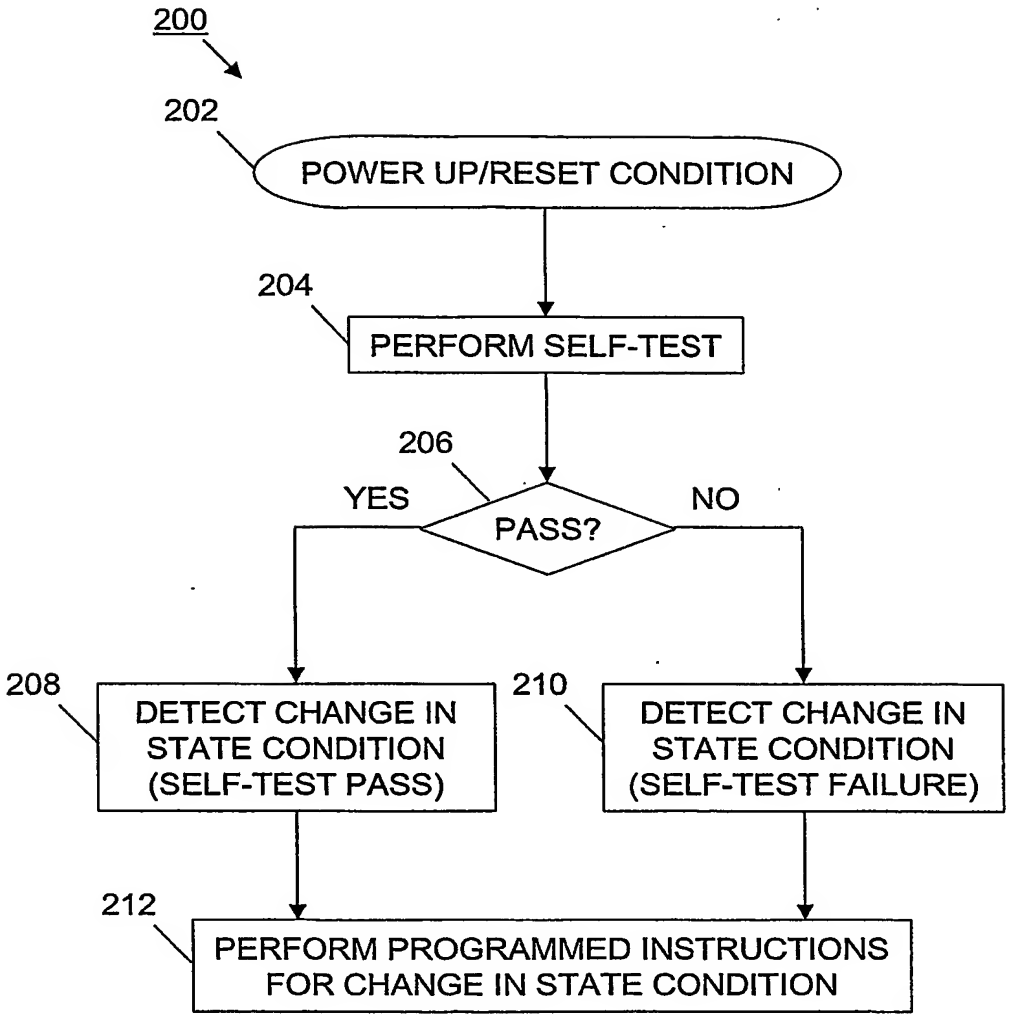
200
202
POWER UP/RESET CONDITION
204
PERFORM SELF-TEST
206
YES
PASS?
NO
208
DETECT CHANGE IN STATE CONDITION (SELF-TEST PASS)
210
DETECT CHANGE IN STATE CONDITION (SELF-TEST FAILURE)
212
PERFORM PROGRAMMED INSTRUCTIONS FOR CHANGE IN STATE CONDITION

FIG. 16

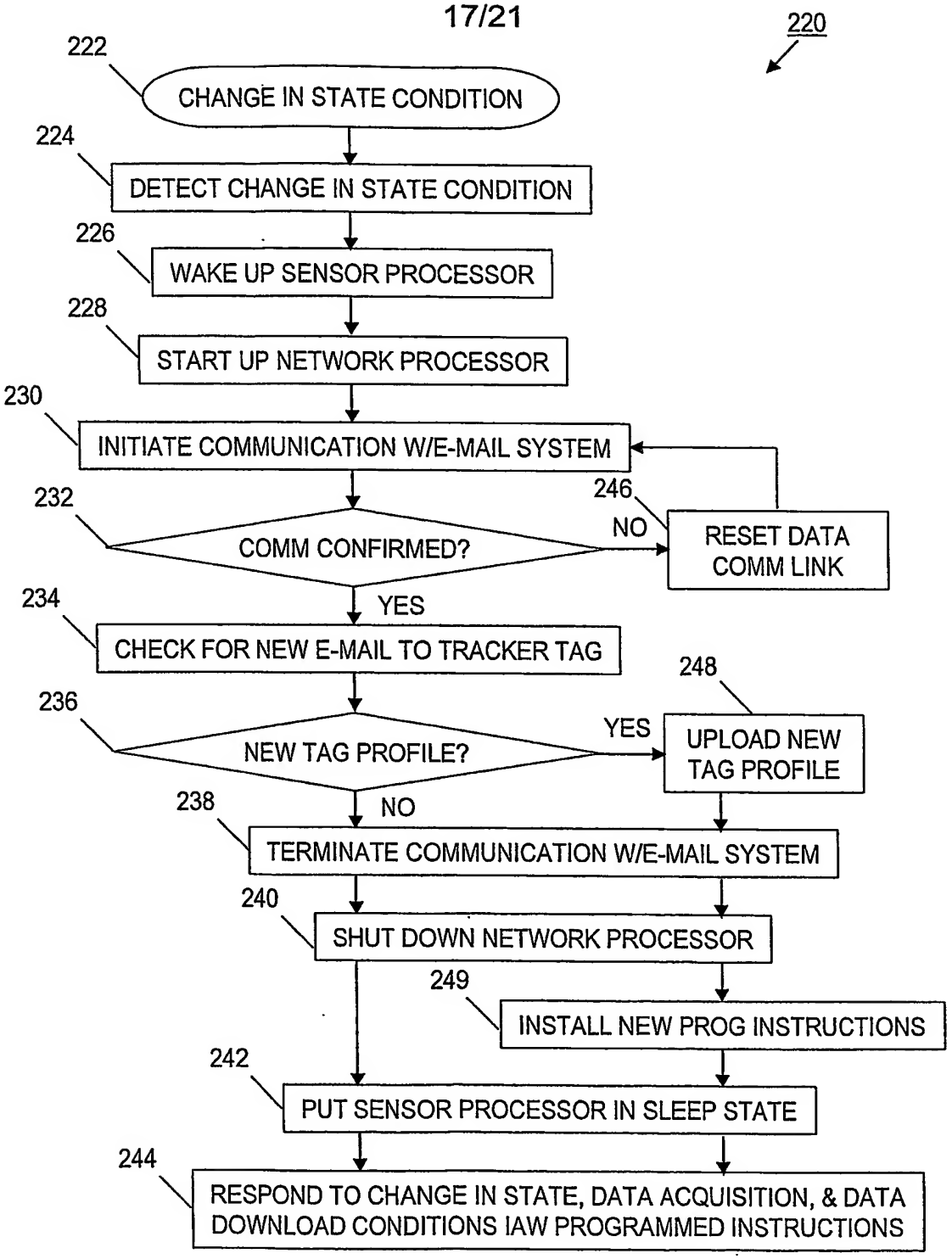
220
222
CHANGE IN STATE CONDITION
224
DETECT CHANGE IN STATE CONDITION
226
WAKE UP SENSOR PROCESSOR
228
START UP NETWORK PROCESSOR
230
INITIATE COMMUNICATION W/E-MAIL SYSTEM
232
COMM CONFIRMED?
NO
246
RESET DATA COMM LINK
YES
234
CHECK FOR NEW E-MAIL TO TRACKER TAG
236
NEW TAG PROFILE?
YES
248
UPLOAD NEW TAG PROFILE
NO
238
TERMINATE COMMUNICATION W/E-MAIL SYSTEM
240
SHUT DOWN NETWORK PROCESSOR
249
INSTALL NEW PROG INSTRUCTIONS
242
PUT SENSOR PROCESSOR IN SLEEP STATE
244
RESPOND TO CHANGE IN STATE, DATA ACQUISITION, & DATA DOWNLOAD CONDITIONS IAW PROGRAMMED INSTRUCTIONS

FIG. 17

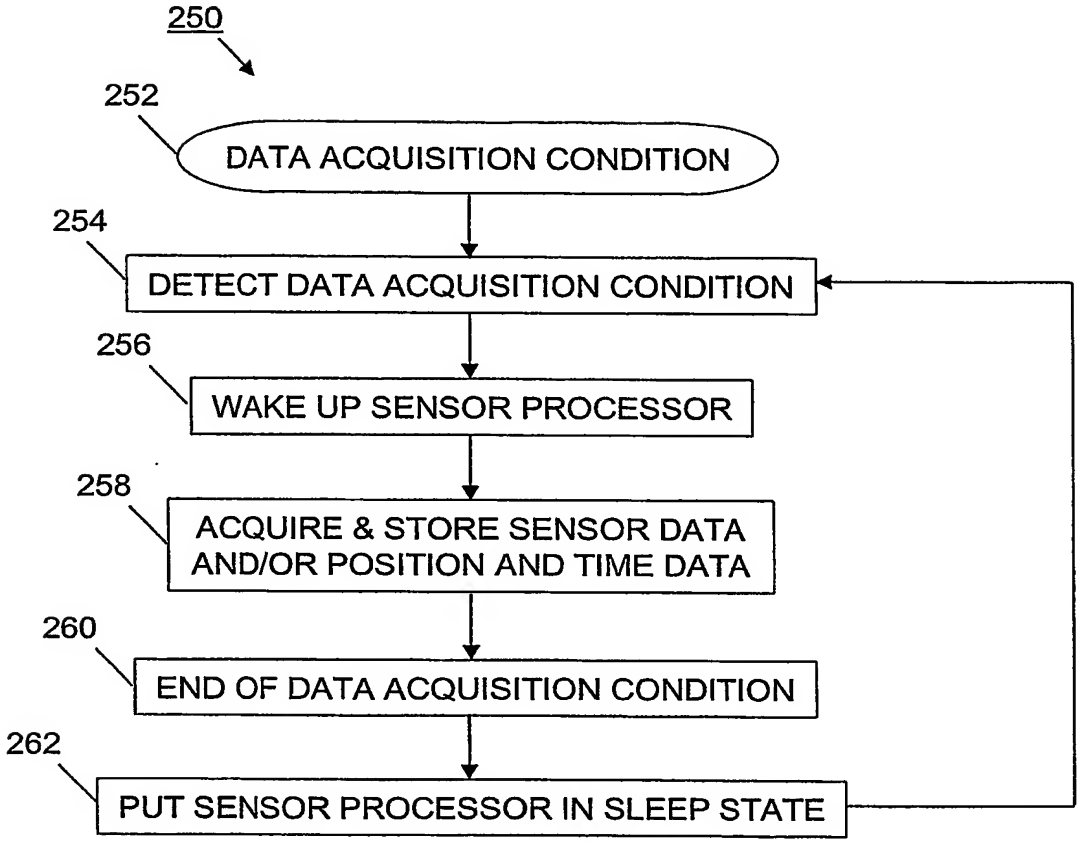
250
252
DATA ACQUISITION CONDITION
254
DETECT DATA ACQUISITION CONDITION
256
WAKE UP SENSOR PROCESSOR
258
ACQUIRE & STORE SENSOR DATA AND/OR POSITION AND TIME DATA
260
END OF DATA ACQUISITION CONDITION
262
PUT SENSOR PROCESSOR IN SLEEP STATE

FIG. 18

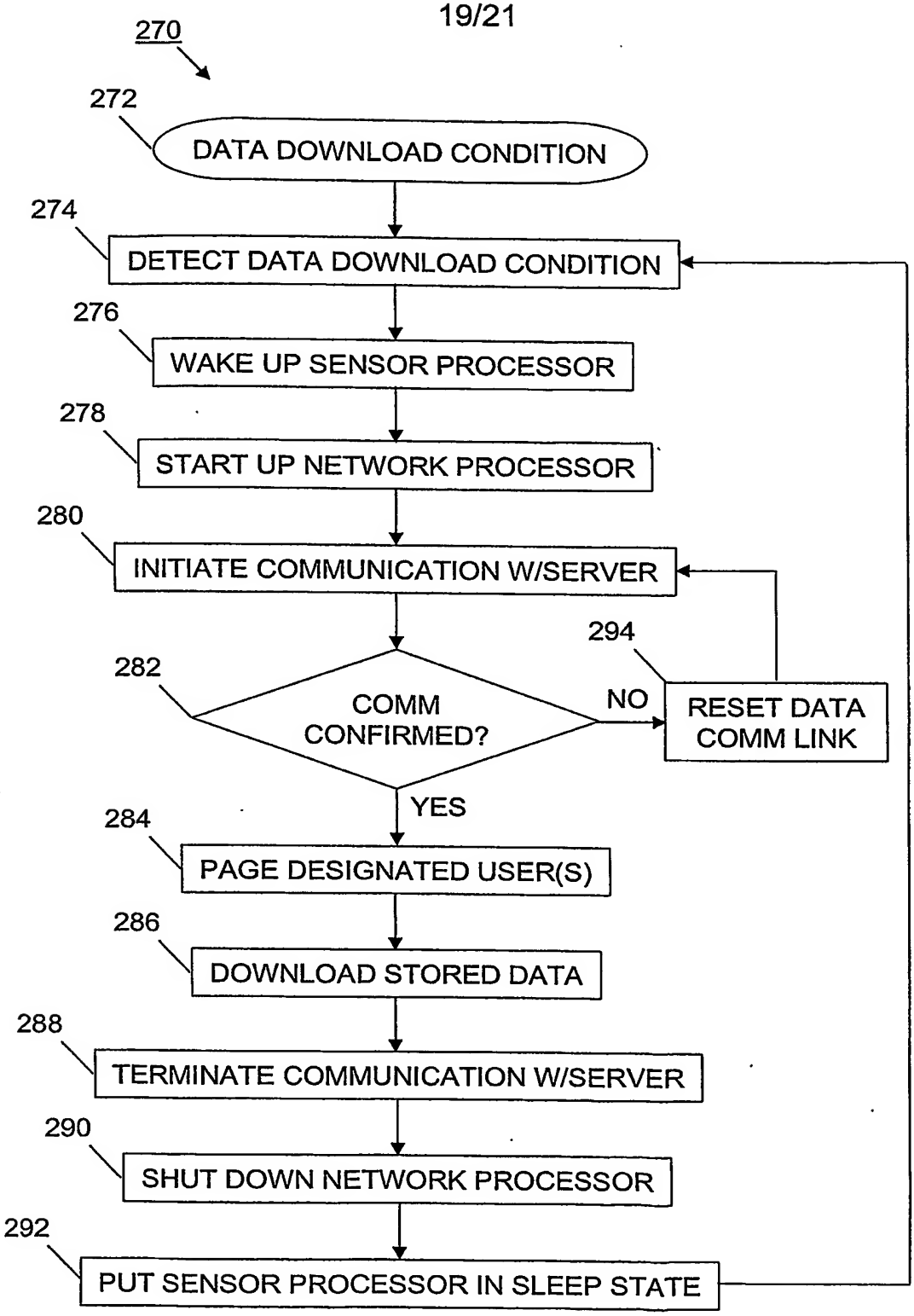
270
272
DATA DOWNLOAD CONDITION
274
DETECT DATA DOWNLOAD CONDITION
276
WAKE UP SENSOR PROCESSOR
278
START UP NETWORK PROCESSOR
280
INITIATE COMMUNICATION W/SERVER
282
COMM CONFIRMED?
NO
294
RESET DATA COMM LINK
YES
284
PAGE DESIGNATED USER(S)
286
DOWNLOAD STORED DATA
288
TERMINATE COMMUNICATION W/SERVER
290
SHUT DOWN NETWORK PROCESSOR
292
PUT SENSOR PROCESSOR IN SLEEP STATE

FIG. 19

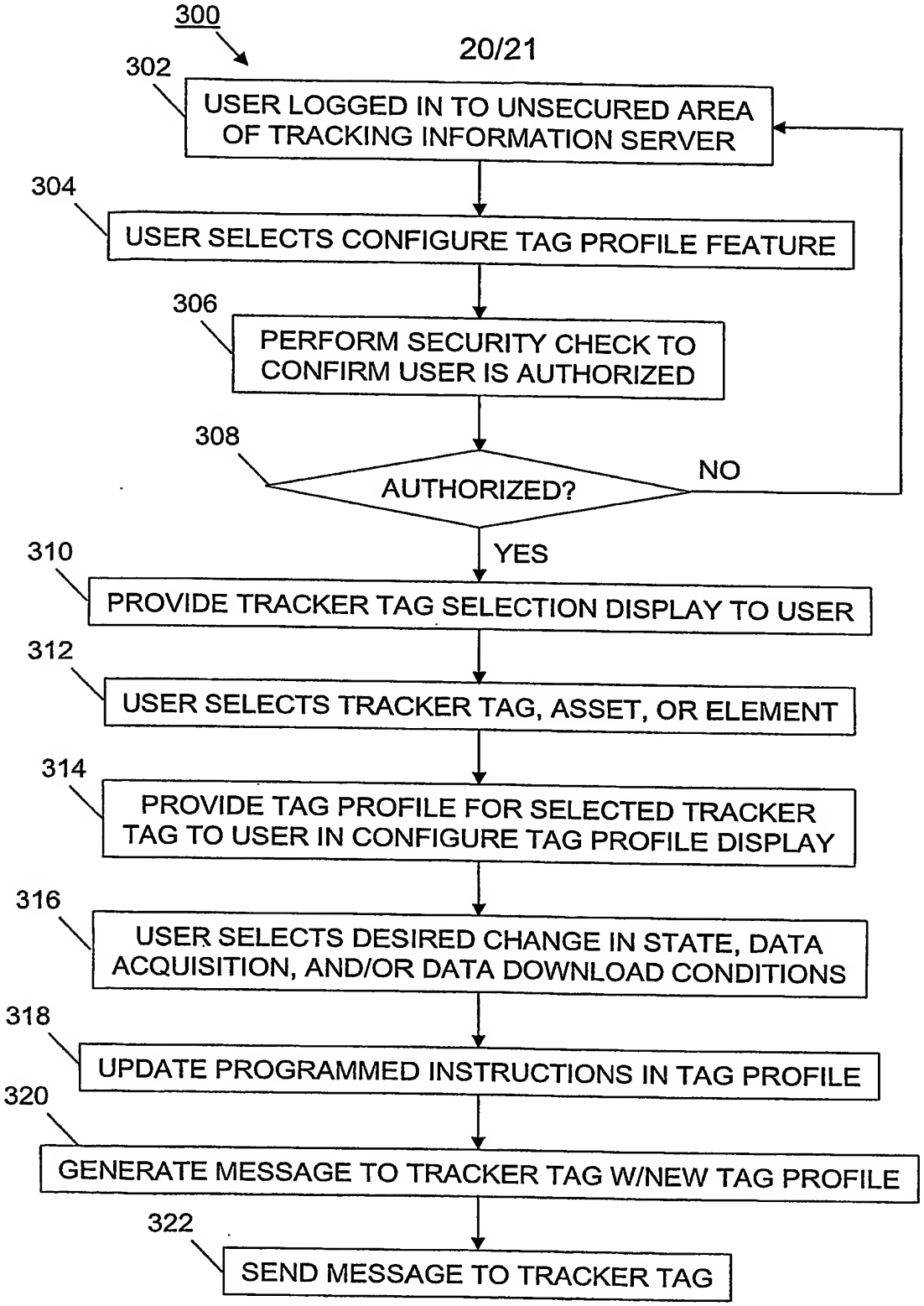
300
302
USER LOGGED IN TO UNSECURED AREA OF TRACKING INFORMATION SERVER
304
USER SELECTS CONFIGURE TAG PROFILE FEATURE
306
PERFORM SECURITY CHECK TO CONFIRM USER IS AUTHORIZED
308
AUTHORIZED?
NO
YES
310
PROVIDE TRACKER TAG SELECTION DISPLAY TO USER
312
USER SELECTS TRACKER TAG, ASSET, OR ELEMENT
314
PROVIDE TAG PROFILE FOR SELECTED TRACKER TAG TO USER IN CONFIGURE TAG PROFILE DISPLAY
316
USER SELECTS DESIRED CHANGE IN STATE, DATA ACQUISITION, AND/OR DATA DOWNLOAD CONDITIONS
318
UPDATE PROGRAMMED INSTRUCTIONS IN TAG PROFILE
320
GENERATE MESSAGE TO TRACKER TAG W/NEW TAG PROFILE
322
SEND MESSAGE TO TRACKER TAG

FIG. 20

79, 104

```
1  TRACKER TAG ID=123456789;
2  # CHANGE IN STATE CONDITION;
3  CISC POSITION;
4  CISC TIME;
5  CISC VIBRATION::TRANSITION ENGINE OFF TO RUNNING;
6  CISC VIBRATION::TRANSITION ENGINE RUNNING TO OFF AND REMAINING
7  OFF 10 MINUTES;
8  CISC TEMPERATURE:: RISING TRANSITION TO > 40 F;
9  CISC TEMPERATURE:: FALLING TRANSITION TO < 40 F AND REMAINING < 40
10 F 5 MINUTES;
11 CISC SELF-TEST-PASS:: YES;
12 CISC SELF-TEST-FAIL:: YES;
13 CISC PAGE;
14 # DATA ACQUSITION CONDITION;
15 DAC POSITION:: ON VIBRATION CHANGE IN STATE, PERIODIC 10 MINUTES
16 WHILE ENGINE RUNNING;
17 DAC TIME:: ON VIBRATION CHANGE IN STATE, PERIODIC 10 MINUTES
18 WHILE ENGINE RUNNING;
19 DAC VIBRATION:: ON VIBRATION CHANGE IN STATE, ALSO ACQUIRE
20 POSITION, ALSO ACQUIRE TIME;
21 DAC TEMPERATURE:: ON TEMPERATURE CHANGE IN STATE, PERIODIC 5
22 MINUTES WHILE > 40 F, ALSO ACQUIRE POSITION, ALSO ACQUIRE TIME;
23 DAC SELF-TEST-PASS:: ON SELF-TEST-PASS CHANGE IN STATE, ALSO
24 ACQUIRE POSITION, ALSO ACQUIRE TIME;
25 DAC SELF-TEST-FAIL:: ON SELF-TEST-FAIL CHANGE IN STATE, ALSO
26 ACQUIRE POSITION, ALSO ACQUIRE TIME;
27 DAC PAGE;
28 # DATA DOWNLOAD CONDITION;
29 DDC POSITION;
30 DDC TIME;
31 DDC VIBRATION:: ON VIBRATION CHANGE IN STATE, PERIODIC 8 HOURS
32 WHILE ENGINE RUNNING, ALSO DOWNLOAD ALL;
33 DDC TEMPERATURE:: ON TEMPERATURE CHANGE IN STATE, PERIODIC 5
34 MINUTES WHILE > 40 F, ALSO DOWNLOAD POSITION AND TIME;
35 DDC SELF-TEST-PASS;
36 DDC SELF-TEST-FAIL:: ON SELF-TEST-FAIL CHANGE IN STATE, ALSO
37 DOWNLOAD POSITION AND TIME;
38 DDC PAGE:: USER 123 FOR ALL DATA DOWNLOAD CONDITIONS;
39 DDC PAGE:: USER 456 FOR SELF-TEST-FAIL DATA DOWNLOAD CONDITION;
```

FIG. 21